

UNITED STATES PATENT APPLICATION

OF

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TITLE: RACK AND TRAY ASSEMBLY FOR FOOT APPAREL

RACK AND TRAY ASSEMBLY FOR FOOT APPAREL

FIELD OF THE INVENTION

5 The present invention relates in general to a rack and tray assembly for storing foot apparel in a residential or commercial setting. More specifically, the present invention comprises means for storing foot apparel and the like while simultaneously allowing for the collection and retention of water, snow and debris temporally released therefrom.

10 BACKGROUND OF THE INVENTION

 Storage of shoes remains a problem especially in the modern home. Today's home equally serves the purpose of providing shelter and creating a physical manifestation of an individual's personality, interests and wealth. To that end modern homes often have grand
15 entrances and/or fine interior treatments such as hardwood floors, expensive carpeting, natural stone tiles, or exotic antique rugs. To protect these interior treatments, homeowners often require occupants and guests to remove their shoes upon entering the home.

 In addition to protecting interior treatments, shoes are often removed to prevent water, snow and debris from entering the home, thus keeping interior surfaces cleaner
20 longer. Children, because of their immaturity and size will often walk in water, snow and debris unwittingly or for fun. Their small size often causes their shoes to contact the surfaces of furniture, as they often need to climb into the normal seating position assumed by an adult.

 Many cultures require the removal of shoes before entering the home for a variety
25 of reasons. In some cultures it is feared that debris carried into the home on shoes will cause sickness in small children who on occasion crawl around the floor surface. Shoes are also removed to maintain clean floors for purposes of religion. For example, having

clean floors is vital for some religious observances that require individuals to occupy the floor several times daily.

Shoes with mild to moderate traction enhancing soles are capable of carrying significant quantities of water, snow and debris into a home. The average shoe can carry upwards of 5 – 10 mL of rain water and as much as 15 – 25 mL of water from melting snow. In regions that experience moderate amounts of snowfall annually, it is a constant battle to prevent water, snow and debris from entering the home. This problem is so significant that architects have sought to address this problem through a home's design by including mud rooms or other designated areas to remove wet-, snow- or mud-covered shoes and garments.

Today, individuals tend to own multiple pairs of shoes and on occasion invite several guests to their home at once. This situation will cause numerous pairs of shoes to accumulate near the door covering a substantial area of the floor. This situation can create a variety of safety hazards. Shoe clutter can prevent the free swinging movement of doors baring entry and exit from a dwelling. As few as one pair of shoes saturated with rain water or melting snow can create a wet slippery floor inviting injury from a fall. Unorganized shoes also create a tripping hazard by their mere presence near the door or otherwise in a home's traffic pattern.

Typically an inexpensive washable rug is often selected to serve as a collection point for shoes. Rugs such as these can quickly become saturated with water and debris thus necessitating frequent cleaning and have a limited shoe capacity as defined by their size. Further inexpensive rugs often do not necessarily complement the interior of today's finely furnished home. Also rugs of this type when saturated with water and debris do little to protect the floor beneath it. Rugs only offer minimal protection to floors because water can soak through most and they do very little to contain the lateral dispersion of debris. With most rugs of this type, shoes can remain in contact with both water and debris for a sustainable period of time. Also, multiple pairs of shoes may end

up being inadvertently stacked atop of one another causing water and debris to contact other shoes risking damage not only to the floor but also to other shoes nearby.

The prior art contains numerous devices for organizing and storing shoes. The typical prior art device consists of a solid frame constructed of wood or plastic with a number of shelves being designated to hold shoes in a predetermined fashion. Still others rely upon another supporting structure such as a door to suspend a series of plastic, fabric or cardboard shelves. These shelves are often constructed in close proximity to one another to maximize the number of shoes stored in the smallest area possible. Such shelves can become damaged by water, snow or mud remaining on shoes placed in them. Since the shelves are placed in close proximity to maximize space this also minimizes air circulation and prolongs drying times for shoes and shelving materials. The shelving materials can quickly become damaged and dirty with no ready or anticipated way to disassemble or clean them.

Other prior art shoe racks possess the capability to store numerous pairs of shoes, but do so in an open design that hangs shoes from hooks, loops or pegs attached to and extending outwardly from the rack. This rack is still not aesthetically pleasing and does not offer sufficient means to collect water or debris from shoes. Another disadvantage of this type of rack, especially in a vertical configuration, is that water and debris from one shoe can impermissibly contact other shoes. These racks can also become damaged and dirty with no ready or anticipated way to disassemble or clean them as hereinbefore mentioned. Also, this type of rack, like many other prior art devices, is incapable or does not allow the user to comfortably sit on the rack to remove shoes prior to placement therewithin.

In accordance with the present invention, applicant has appreciably devised a shoe rack and tray assembly that is aesthetically pleasing for the modern home, can store and organize one or more pairs of shoes, can protect the interior space of a home and prevent damage to the rack itself or other shoes, can contain ample amounts of water, snow or debris, and is easily removed from its location for emptying and thorough cleaning.

BRIEF SUMMARY OF THE INVENTION

In order to overcome the numerous drawbacks apparent in the prior art, a rack and tray assembly has been devised for organizing and storing foot apparel in a residential
5 and commercial setting.

It is thus an object of the present invention to provide a rack and tray assembly to
shelve shoes in an aesthetically pleasing manner for the modern home.

It is another object of the present invention to provide such a rack and tray
assembly capable of containing ample amounts of water, snow and debris originating
10 from foot apparel and the like.

It is another object of the present invention to provide a rack and tray assembly
that allows adequate air circulation for drying shoes while simultaneously allowing water,
snow and debris to separate from soles or bottom surfaces of foot apparel and the like.

It is another object of the present invention to provide a rack and tray assembly
15 capable of being easily removed from its location for emptying collected water, snow and
debris released from foot apparel.

It is another object of the present invention to provide a rack and tray assembly
comprising a cushioned seat to comfortably allow one to sit and remove shoes for
subsequent placement into the rack and tray assembly.

20 It is yet another object of the present invention to provide a rack and tray assembly
which accomplishes the foregoing and other objects and advantages and which is
economical, durable, and fully effective in performing its intended functions without
unduly compromising the entryway of residential and commercial buildings.

In accordance with the present invention, a rack and tray assembly has been
25 devised for storing foot apparel and collecting debris and liquids released therefrom, the
assembly comprising a cabinet having left and right sidewalls integrally connected to top
and bottom sides collectively forming a box-like structure having an interior

compartment for housing therein at least one tray; the tray comprising inclined sides extending upwardly from a base and terminating an upper rim collectively forming a reservoir for holding and retaining water, snow, and debris released from foot apparel; the upper rim comprising a ledge having an upper exposed surface for receiving thereon a grate and a lower exposed surface for engaging an upper portion of guide rails fixedly attached to the left and right sidewalls for which substantially serve to position the tray above the floor to prevent inadvertent spillage while in use to support foot apparel bearing water, snow, and debris.

Other objects, features, and advantages of the present invention will become apparent in the following detailed description of the preferred embodiments thereof when read in conjunction with the accompanying drawings in which like reference numerals depict the same parts in the various views.

BRIEF DESCRIPTION OF THE DRAWINGS

A preferred embodiment of the present invention will now be described by way of example with reference to the accompanying drawings, in which:

FIGURE 1 is a front perspective view of a preferred embodiment of the present invention illustrating a tray fitted with a grate collectively positioned within an interior compartment of a cabinet;

FIGURE 2 is a top plan view of the preferred embodiment of the present invention illustrating a tray;

FIGURE 3 is a front perspective view of the preferred embodiment of the present invention illustrating a tray;

FIGURE 4 is a top plan view of the preferred embodiment of the present invention illustrating a tray fitted with a grate;

FIGURE 5 is a front perspective view of the preferred embodiment of the present invention illustrating a tray fitted with a grate having a pair of shoes resting thereon;

FIGURE 6 is a front perspective view of an alternative embodiment of the present invention illustrating a folding frame structure fitted with a pair of tray support
5 assemblies each comprising a tray positioned therebelow;

FIGURE 7 is a mirror end view of the alternative embodiment of the present invention illustrating a pair of tray support assemblies positioned in between elongate vertical members of a leg;

FIGURE 8 is a top plan view of the alternative embodiment of the present
10 invention illustrating a tray support assembly positioned in between left and right legs;

FIGURE 9 is a front cross sectional view of the alternative embodiment of the present invention taken on line 9—9 of FIG. 8 illustrating a pair of tray support assemblies positioned in between left and right legs;

FIGURE 10 is a side elevational view of the alternative embodiment of the present
15 invention illustrating an L-shaped member having upper and lower positioning plates;

FIGURE 11 is a front elevational view of the alternative embodiment of the present invention illustrating a rod having threaded ends situated in between a pair of L-shaped members each having upper and lower positioning plates;

FIGURE 12 is a perspective view of the alternative embodiment of the present
20 invention illustrating a tray rail comprising a pair of L-shaped members each having upper and lower positioning plates and connectively fastened together by a rod;

FIGURE 13 is a front perspective view of the alternative embodiment of the present invention illustrating a tray suspended below a plurality of support members by a pair of tray rails; and

FIGURE 14 is a partial perspective view of the alternative embodiment of the present invention illustrating a tray rail comprising a pair of L-shaped members connected to and suspended below a plurality of support members.

5 DETAILED DESCRIPTION OF THE INVENTION

While this invention is susceptible of being embodied in many different forms, the preferred embodiment of the invention is illustrated in the accompanying drawings and described in detail hereinafter with the understanding that the present disclosure is to be
10 considered to exemplify the principles of the present invention and is not intended to limit the invention to the embodiments illustrated and presented herein. The present invention has particular utility as a device for holding and storing foot apparel and the like and collecting and retaining water, snow and debris temporally released therefrom.

Referring now to FIG. 1, there is shown generally at 10 a rack and tray assembly
15 comprising a cabinet 12 having left and right sidewalls 14, 16 integrally connected to top and bottom sides 18, 20 collectively forming a box-like structure 22 having an interior compartment 24 for housing therein at least one tray 26. In the preferred embodiment, the left and right sidewalls each comprise an inner planer surface 14a, 16a for locating and mounting thereon at least one set of left and right guide rails 14b, 16b, respectively.
20 As depicted in FIG. 1, each guide rail of elongate form protrudes outwardly in perpendicular fashion from the inner planer surface a predetermined distance to slidably accept a portion of the tray and support the weight of the tray and any shoes, water, snow or debris it may contain. A pair of rotatable lock mechanisms 28 pivotally fastened to a front leading edge 30 of the combined arrangement of the left and right sidewalls and top
25 and bottom sides suitably prevents inadvertent movement of the tray 26 out and away from the cabinet 12 in instances where foot apparel traverses the tray and is removed from the cabinet. Accordingly, each rotatable lock mechanism is positioned adjacent to the left and right guide rails 14b, 16b to suitably intercept and engage the tray upon the

above-noted event. To allow level placement of the tray 26 while housed within the interior compartment 24, the left guide rail is mounted to the left sidewall and positioned parallel to the right guide rail mounted to the right sidewall. It is noted herein that each guide rail 14*b*, 16*b* may be mounted to the inner planer surface in any acceptable manner known in the art, such as screws threadably extending through the guide rail and terminating into the sidewall. Preferably, a minimum distance of approximately 8" is maintained in between one set of guide rails and the top side 18 of the cabinet or another set of guide rails to allow sufficient clearance therewithin for the tray and any foot apparel placed thereupon. Similarly, a minimum distance of approximately 2" is maintained in between one set of guide rails and the bottom side 20 of the cabinet to allow clearance for the tray for purposes of installation and removal. In some applications, the cabinet 12 may comprise a cushioned seat 32 fixedly attached to the top side 18 to provide convenient means for removal and placement of foot apparel from and onto the wearer. In this instance, the cabinet is structural reinforced by a back panel 34 attached along a back leading edge 36 of the left and right sidewalls and top and bottom sides.

The tray 26 primarily serves as a reservoir for collecting water, snow and debris released from the foot apparel. As shown in FIG. 2, the tray preferably comprises a base 38 integrally connected to inclined sides 40 extending upwardly therefrom, along the periphery thereof and terminating at an upper rim 42. The inclined sides primarily function to prevent the accumulation of debris thereabout while allowing continuous flow downwardly toward the base to ensure full usage of the tray's volumetric capacity. In most applications, the inclined sides are positioned outwardly in angular fashion by approximately 25° to an axis perpendicular to the base to further this purpose, as best illustrated along path M in FIG. 3. The upper rim 42 comprises a ledge 44 having an upper exposed surface 46 for receiving thereon a grate 48 and a lower exposed surface 50 for engaging an upper portion 52 of the guide rail. Integrally made part of the rim is a supportive wall 54 extending upwardly from the upper exposed surface of the ledge 44.

The supportive wall primarily serves as means for maintaining the orientation and position of the grate while positioned atop the upper exposed surface and reinforcing the structural integrity of the rim 42 while bearing loads comprising foot apparel, water, snow, and debris. As shown in FIG. 4, the grate comprises a frame 56 having an overall geometric configuration corresponding to the arrangement of the ledge insofar to allow the frame to rest entirely upon the upper exposed surface 46. A plurality of support members 58 positioned within and integrally connected to the frame 56 collectively serve as means for supporting foot apparel while simultaneously allowing the passing of water, snow and debris into the tray 26. Accordingly, the support members are positioned parallel to and spaced equally apart from one another within the frame to form and define a plurality of elongate openings 60. It is noted herein that the orientation and spacing of the supporting braces may vary in each application to accommodate a variety of shoe types yet affording passage of water, snow and debris collectively released therefrom. For instance, the support members of elongate configuration as illustrated in FIG. 4 may extend parallel to a pair of shortened end members 62 of the frame and connect to and terminate at side members 64 of the frame to enhance the overall structural integrity of the grate to the extent of mitigating deformation of the grate upon placing heavily weighted foot apparel thereon. Preferably, the frame as well as the support members fitted therewithin collectively comprises a uniform height suitably corresponding to the height of the supportive wall 54. This configuration ensures that the rim 42 and its structural features do not unduly interfere with the foot apparel as it is slidably removed from and placed about the grate 48, notably in instances where the tray 26 remains stationary within the cabinet 12 or is used as a standalone device as shown in FIG. 5. The grate in its preferred embodiment is constructed of strong lightweight metal coated with vinyl. Lightweight metal suitably serves in strengthening the grate to maintain rigidity while lessening the overall weight of the tray and grate to enhance its handling capacity. The vinyl coating is an attractive inexpensive material to provide corrosion protection to metal that may contact water and snow released from the foot apparel. It is anticipated that any material comprising the above-noted characteristics, such as wood, plastic,

carbon fiber, or a combination thereof, may be used to construct the grate providing it offers resistance to premature corrosion during normal usage. In typical applications, the tray preferably comprises a width of approximately 24" and a length of approximately 16", forming a surface area notably capable of holding two large pairs of shoes. In regard to this rectangular dimension and a depth of approximately 1.5", the tray sufficiently comprises a volumetric capacity to hold and retain a liquid and solid mixture released from approximately ten pairs of shoes over a 1-2 week period. More continuous usage, particularly during snowy conditions, may necessitate frequent handling of the tray for purposes of emptying and cleaning or usage of a tray having a larger volumetric capacity to what has been described for the preferred embodiment.

In an alternative embodiment, as depicted in FIG. 6, the tray 26 absent the grate 48 is fitted within a folding frame structure 66, collectively capable of supporting foot apparel and collecting and retaining water, snow or debris that may be released therefrom to the likes of the preferred embodiment. This alternative embodiment to the cabinet 12 comprises left and right legs 68, 70 pivotally fastened to at least one tray support assembly 72 situated thereinbetween. As shown in FIG. 7, each leg comprises upper and lower elongate horizontal members 68a, 70a, 68b, 70b and a pair of elongate vertical members 68c, 70c each having ends fastened to one another to form a leg of rectangular configuration. Although the legs primarily function to support the tray support assembly, the upper horizontal members may supplement as means for handling the folding frame structure, particularly useful in carrying the folding frame structure 66 from location to location and facilitating assembly and disassembly. Preferably, each leg 68, 70 is integrally construction from a continuous piece of tubing and bent accordingly to form the desired rectangular shape of the leg. Each vertical member comprises an inner face 68d, 70d for engaging and mounting thereon a portion of the tray support assembly. As shown in FIG. 8, each tray support assembly 72 comprises forward and aft horizontal supports 74, 76 positioned parallel to one another with each horizontal support having a pair of ends 74a, 76a affixed to the left and right legs. Each end of the horizontal support

comprises a stem 74b, 76b extending outwardly and perpendicular therefrom to engage and fit into an aperture 78 extending into and through the inner face 68d, 70d of each vertical member, which collectively serve as means for allowing the tray support assembly to simultaneously fold together with each of the legs for short- or long-term storage of the folding frame structure 66. Preferably, each stem comprises a predetermined length which allows for secure placement within the aperture while avoiding interference or binding with an outer face 68e, 70e of each vertical member. Like the structure noted for the grate 48, the tray support assembly 72 further comprises a plurality support bars 80 of elongate form positioned parallel to one another and situated perpendicular and connected at their ends to the horizontal supports 74, 76 to collectively form a plurality of lengthened openings 82, which suitably allow for placement and support of foot apparel while allowing uninhibited passage of water, snow and debris therethrough into the tray 26, as best illustrated in FIGS. 8 and 9. It is noted herein that the size of the lengthened openings may be altered in such a manner to accommodate specific needs, number, or configuration of the foot apparel. In order to prevent frictional binding of the horizontal support with that of the vertical member during pivotal movement, the support bars 80 comprise a predetermined length to establish the tray support assembly's size to fit accordingly within the confines of each leg 68, 70, preferably establishing a ¼" space in between the inner face and horizontal support. To enhance rigidity of the folding frame structure and maintain a perpendicular orientation of the tray support assembly 72 relative to the legs, each horizontal support comprises a pair of angular braces 84 each having top and bottom ends 84a, 84b. As illustrated in FIG. 6, the bottom end of each angular brace comprises an aperture 86 for receiving therethrough a fastener 88, rivet, or equivalent type of fastener which extends into and terminates within each horizontal support 74, 76. The top end of the angular brace is mounted to the vertical member 68c, 70c in such a manner as to allow the angular brace to extend approximately 45° to the longitudinal axis of the tray support assembly 72. Mounting of the angular brace 84 at this preferred angular relation is accomplished by a hook 90 integrally made part of the top end 84a. A pin 92 extending outwardly and

perpendicular from the inner face 68*d*, 70*d* primarily functions to engage an inner space 90*a* of the hook and position the angular brace accordingly. In preferred applications, the inner space of the hook comprises a diameter which suitably promotes a frictionally fit about the pin. As shown in FIG. 7, each pin 92 comprises an end cap 94 to prevent the
5 top end 84*a* of the angular brace from becoming inadvertently disengaged by the occurrence of lateral movement of the tray support assembly 72. A space 96 formed in between the inner face of the vertical member and end cap substantially corresponds to the thickness of the material to construct the angular brace 84, collectively configured to mitigate inadvertent release of the angular brace from the pin 92 and maintain rigidity to
10 the folding frame structure 66 while in an assemble state. In preventing each of the angular braces from interfering or binding with the inner face 68*d*, 70*d* upon collapsing the folding frame structure, each angular brace 84 further comprises an offsetting intermediate member 98 integrally connected to and situated within the top and bottom ends 84*a*, 84*b*. The degree to which the angular brace is offset depends on the geometric
15 configuration of the tray support assembly 72 and its ability to move and be located within the confines of the leg.

Connected to and hanging downwardly from the tray support assembly 72 are left and right tray rails 100, 102 for slidably receiving the tray 26. Each tray rail, as illustrated in FIGS. 6 and 7, comprises a pair of L-shaped members 104 each having
20 vertical and horizontal elements 104*a*, 104*b*. The vertical element comprises a first end 106 integrally connected to the horizontal support 74, 76 and a second end 108 integrally connected to an end 110 of the horizontal element extending outwardly and perpendicular from the vertical element 104*a*. A rod 112 extending from and integrally connected to a free end 114 of each of the horizontal elements 104*b* serves in supplementing the strength
25 of the tray rail 100, 102 to the extent of supporting the collective weight of the tray 26, foot apparel, and accumulating water, snow, and debris. Preferably, each horizontal element comprises a length substantially corresponding to the depth of the ledge to receive and adequately support the tray. To promote sliding of the tray in and out of the

tray rails, each tray 26 comprises an effective length slightly less than the distance maintained in between the pair of tray rails 100, 102 mounted below the horizontal supports 74, 76. In other embodiments noted herein, as shown in FIGS. 10 and 11, each L-shaped member 104 may comprise a plate assembly 116 affixed to the first end 106 of the vertical element to facilitate removal and installation from and to the tray support assembly 72 as well as being used in applications where a grating arrangement is provided and comprises a configuration substantially equivalent to the arrangement of the support members 58 contained within the frame 56 in the preferred embodiment or the support bars 80 contained within the tray support assembly 72 in the alternative embodiment. For instance, a wire rack of the type used in typical shelving installations as well as many other available uses may suitably accept for installation the tray rails 100, 102 equipped with the plate assembly. The plate assembly 116, as illustrated in FIGS. 10 and 12, comprises upper and lower positioning plates 118, 120 each having a pair of concave runners 122 extending parallel to one another with each runner being shaped to substantially conform to the geometric configuration of the support bars 80 or support members 58. For illustrative purposes, the upper positioning plate is positioned atop the support members with the concave runners facing downwardly to engage a top side 124 of the support members, as shown in FIG. 13. In like manner, the lower positioning plate is positioned below the support members with the concave runners of the upper positioning plate facing upwardly to engage a bottom side 126 of the support members. As depicted in FIG. 13, the upper and lower positioning plates 118, 120 are held together about the support member 58 by a screw 128 extending downwardly from the upper positioning plate and through the lower positioning plate and terminating at or near the first end 106 of the vertical element. To ensure proper orientation and alignment of each of the tray rails and prevent inadvertent twisting upon slidably moving the tray 26 in and out from the tray rails 100, 102, the free ends of the horizontal element, like the preferred embodiment, are connectively fastened together by an elongate support 130. However, to further provide for assembly and disassembly of the tray rails from the support members 58, support bars 80 or an equivalent grating structure, the elongate

support comprises threaded ends 132 threadably fitted into a threaded portion 134 of each of the free ends substantially in the manner shown in FIGS. 12 and 14.

5 In operation of the preferred embodiment, the tray 26 is simply fitted with the grate and collectively placed into the cabinet 12 by slidably positioning the ledge of the rim onto the guide rail 14*b*, 16*b* and moving the collective arrangement inwardly until the front supportive wall of the tray sits flush with the front leading edge 30 of the left and right sidewalls 14, 16. Alternatively, the tray and grate combination may simply be located near the entryway as a standalone, operating device or placed within a shelf assembly suitably constructed to support the weight of the tray, grate, and collected waste
10 mixture.

In operation of the alternative embodiment, as structural noted hereinbefore, the folding frame structure 66 is opened if presently in a collapsed state by handling the upper elongate horizontal member 68*a* of the left leg and lower elongate horizontal member of the right leg or vice versa and pulling outwardly from one another until the
15 tray support assembly 72 is positioned perpendicular to the elongate vertical members of the leg 68, 70. Once in this position, each angular brace 84 is pivotally moved about the fastener 88 attached to the horizontal support and positioned accordingly to permit the top end bearing the hook to engage the pin. The tray 26 absent the grate 48 is then slidably positioned onto the tray rails 100, 102 of the tray support assembly, ensuring that
20 the lower exposed surface 50 of the ledge fully rests upon and contacts the horizontal elements 104*b* of the L-shaped members and rods 112 or elongate support 130.

It can be seen from the foregoing that there is provided in accordance with this invention a simple and easily operated device, which is particularly suitable for supporting foot apparel and collecting and retaining water, snow, and debris temporally
25 released therefrom. The rack and tray assembly is completely functional in terms of ridding water and debris from an entryway of a residential or commercial building structure while providing means for localizing the storage of foot apparel and the like. It is obvious that the components comprising the rack and tray assembly may be fabricated

from a variety of materials, providing such selection or use of materials possess the capacity to withstand forces acting thereon throughout its duration of use in a residential or commercial setting. Accordingly, it is most desirable, and therefore preferred, to construct the tray from plastic and grate and folding frame structure from steel suitably coated with vinyl or an equivalent surface material capable of preventing premature corrosion of the substrate. To lessen the cost and simplify construction of the rack and tray assembly 10, the tray support assembly 72, legs 68, 70 and grate 48 are preferably fabricated from unified pieces of tubular metal, with the tray being injected molded in the form noted herein to meet its desired utility.

While there has been shown and described a particular embodiment of the invention, it will be obvious to those skilled in the art that various changes and alterations can be made therein without departing from the invention and, therefore, it is aimed in the appended claims to cover all such changes and alterations which fall within the true spirit and scope of the invention.